CLAIMS

What is claimed is:

1. A method for controlling a patient's heart rate, comprising:

positioning a vagal electrode proximate to the patient's right vagus nerve near the patient's cardiac branch;

positioning an atrial electrode in the patient's atrium;

detecting the patient's atrial rate; and

delivering stimulation pulses to the vagal electrode when a fast atrial rate is detected, the stimulation pulses being delivered at a level that reduces the atrial rate to a normal operating range.

2. The method of claim 1, wherein the delivering step comprises:

adjusting the level of stimulation pulses so that the atrial rate decreases to a predetermined lower atrial rate.

3. The method of claim 2, wherein adjusting the level of stimulation pulses comprises:

adjusting the level of stimulation pulses so that the atrial rate decreases to within a normal range.

4. The method of claim 2, wherein adjusting the level of stimulation pulses comprises:

adjusting the level of stimulation pulses so that the atrial rate decreases to substantially half of the detected fast atrial rate.

5. The method of claim 2, wherein adjusting the level of stimulation pulses comprises:

adjusting at least one of amplitude, pulse width and frequency.

6. The method of claim 5, wherein adjusting of the level of stimulation pulses further comprises:

testing a plurality of amplitude, pulse width and frequency combinations;

recording current drain for the plurality of amplitude, pulse width and frequency combinations;

determining at least one combination of amplitude, pulse width and frequency that reduces current drain; and

delivering the stimulation pulses to the vagal electrode at a level that reduces the atrial rate to the predetermined lower rate while reducing current drain.

7. The method of claim 5, wherein adjusting of the level of stimulation pulses further comprises:

varying a plurality of amplitude, pulse width and frequency combinations to determine whether varying degrees of lower atrial rates can be achieved;

recording corresponding atrial rates for the plurality of amplitude, pulse width and frequency combinations; and

selecting a particular amplitude, pulse width and frequency combination that corresponds to the predetermined lower atrial rate.

8. The method of claim 2, further comprising:

positioning a ventricular electrode in the patient's ventricle;

monitoring A-V conduction intervals; and

wherein the delivering step comprises delivering stimulation pulses at a level that does not cause A-V dissociation.

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9. The method of claim 8, wherein the adjusting step further comprises:

determining a plurality of operating parameter combinations that do not cause A-V dissociation, each combination including a stimulation pulse amplitude, frequency and pulse width;

recording the resultant heart rate reduction for each combination; and

wherein the delivering comprises delivering the stimulation pulses to the vagal electrode using the operating parameter combination that substantially achieves the predetermined lower atrial rate.

10. The method of claim 8, wherein the adjusting of the level of stimulation pulses further comprises:

recording current drain for the plurality of operating parameter combinations that do not cause A-V dissociation; and

wherein the delivering comprises delivering the stimulation pulses to the vagal electrode using the operating parameter combination that reduces the atrial rate without A-V dissociation and reduces current drain.

11. The method of claim 1, further comprising:

periodically discontinuing delivering of the stimulation pulses to the vagal electrode;

testing to determine if the atrial rate has returned to a normal range;

disabling the delivery of the stimulation pulses to the vagal electrode when the atrial rate is in a normal range; and

continuing the delivery of the stimulation pulses to the vagal electrode when the fast atrial rate is still present.

12. The method of claim 1, wherein the positioning comprises positioning the vagal electrode in the right azygos vein.

13. The method of claim 12, wherein the positioning the vagal electrode in the right azygos vein comprises deploying an expandable vagal electrode configured to make contact with tissue proximate to the vagus nerve.

14. The method of claim 1, wherein the positioning comprises positioning the vagal electrode in the Superior Vena Cava (SVC) near the right cardiac branch.

15. The method of claim 14, wherein the positioning the vagal electrode in the SVC comprises deploying an expandable vagal electrode configured to make contact with tissue proximate to the vagus nerve and the right cardiac branch.

16. An implantable stimulation lead for enhancing a patient's vagal tone, comprising:

a transvenous lead body having an insulating sheath surrounding at least one conductor, the at least one conductor being coupled to at least one proximal connector; and

an electrode portion, coupled to the conductor, configured to be positioned within a patient's azygos vein and dimensioned to make contact with tissue proximate to the cardiac branch of the right vagus nerve.

17. The implantable lead of claim 16, whereing the lead body comprises a preformed turn that orients the electrode portion into the patient's azygos vein.

18. The implantable lead of claim 16, wherein the lead body comprises a single-pass lead body having at least one electrode configured to be positioned in a desired chamber of the patient's heart, the single-pass lead body further comprising a side-arm that branches near, and directs the electrode portion into, the patient's azygos vein.

19. The implantable lead of claim 16, whereing the electrode portion comprises at least one electrode facing towards the patient's vagus nerve.

20. The implantable lead of claim 16, wherein:

the electrode portion comprises an expandable electrode that is dimensioned to expand and anchor against the azygos vein.

21. The implantable lead of claim 20, wherein:

the expandable electrode is one of a basket electrode, an umbrella-type electrode or spiral electrode.

22. The implantable lead of claim 16, further comprising:

a distal tail, coupled to a distal end of the electrode portion, that extends into the azygos vein to provide stabilization.

23. The implantable lead of claim 22, wherein the distal tail comprises at least one of a hook, a tine, a spiral or a pre-formed bend capable of anchoring the distal tail in a desired position.

24. The apparatus of claim 16, wherein the lead body comprises a single-pass lead body having at least a second and a third electrode portion positionable within a first and second chamber of the patient's heart such that at least A-V synchrony can be monitored.

25. The apparatus of claim 16, wherein the lead body comprises a single-pass lead body having at least a second and a third electrode positionable within a first and second chamber of the patient's heart such that at least A-V synchrony can be maintained.

26. The apparatus of claim 16, wherein the lead body comprises a single-pass lead body having at least a second and a third electrode positionable proximate to a first and second chamber of the patient's left heart via the coronary sinus region such that at least A-V synchrony and left-sided stimulation therapy can be maintained.

27. An implantable single-pass stimulation lead for controlling a patient's atrial rate, comprising:

a transvenous lead body having an insulating sheath having first and second conductors, the first and second conductors being electrically isolated and coupled to first and second proximal terminals;

an atrial electrode, coupled to the first conductor, and configured on the lead body so as to be capable of sensing atrial signals; and

an electrode portion, coupled to the second conductor, configured to be positioned within a patient's superior vena cava (SVC) and dimensioned to make contact with tissue proximate to the cardiac branch of the right vagus nerve.

28. The implantable lead of claim 27, whereing the electrode portion comprises at least one electrode facing towards the patient's vagus nerve.

29. The implantable lead of claim 27, wherein:

the electrode portion comprises an expandable electrode that is dimensioned to expand and anchor against the azygos vein.

30. The implantable lead of claim 29, wherein:

the expandable electrode is one of a basket electrode, an umbrella-type electrode or spiral electrode.

31. The apparatus of claim 27, wherein the single-pass lead body further comprises a ventricular electrode configured on the lead body so as to be capable of sensing ventricular signals such that at least A-V synchrony can be monitored.

32. The apparatus of claim 27, wherein the single-pass lead body further comprises a ventricular electrode configured on the lead body so as to be capable of sensing ventricular signals such that at least A-V synchrony can be maintained.

33. The apparatus of claim 27, wherein the single-pass lead body further comprises a ventricular electrode configured on the lead body so as to be capable of sensing atrial and ventricular signals when implanted within the coronary sinus region such that at least A-V synchrony and left-sided stimulation therapy can be maintained.